

Appl. No. : 10/007,304  
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CLEAN VERSION OF THE CLAIMS

35. A diffusion barrier for a copper interconnect comprising a layer of metal nitride covered by a layer of reactive metal different from a metal in the metal nitride layer, wherein the grain boundaries of the metal nitride layer are stuffed with a metal compound of the reactive metal.

36. The diffusion barrier of Claim 35, wherein the metal nitride is selected from the group consisting of titanium nitride, tungsten nitride and tantalum nitride.

37. The diffusion barrier of Claim 36, wherein the metal nitride is titanium nitride.

38. The diffusion barrier of Claim 35, wherein the reactive metal is selected from the group consisting of Al, Si, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mg, Y and La.

39. The diffusion barrier of Claim 38, wherein the reactive metal is Al.

40. The diffusion barrier of Claim 38, wherein the reactive metal is Si.

41. The diffusion barrier of Claim 38, wherein the reactive metal is a lanthanide.

42. The diffusion barrier of Claim 35, wherein the reactive metal is selected from the group consisting of metals of group IIIB of the periodic table, metals of group IVB of the periodic table, metals of group VB of the periodic table and metals of group VIB of the periodic table.

43. (Amended) The diffusion barrier of Claim 35, wherein the metal compound is an oxide of the reactive metal.

44. (Amended) The diffusion barrier of Claim 43, wherein the metal compound is selected from the group consisting of aluminum oxide and silicon oxide.

45. (Amended) The diffusion barrier of Claim 35, wherein the metal compound is a nitride of the reactive metal.

46. (Amended) The diffusion barrier of Claim 45, wherein the metal compound is selected from the group consisting of aluminum nitride and silicon nitride.

47. The diffusion barrier of Claim 35, wherein the metal nitride layer is about 5 to 10 nm thick.

48. The diffusion barrier of Claim 35, wherein the reactive metal layer is about 2 nm thick.

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49. The diffusion barrier of Claim 35, additionally comprising a second layer of metal nitride over the layer of reactive metal.

50. (Amended) A diffusion barrier for a copper interconnect comprising:  
a first layer of metal nitride;  
a layer of reactive metal over the first layer of metal nitride; and  
a second layer of metal nitride over the layer of reactive metal, wherein the grain boundaries of the first and second metal nitride layers are stuffed with a compound of a metal different from the metal in the nitride layers.

51. (Amended) The diffusion barrier of Claim 50, wherein the compound of a metal different from the metal in the nitride layers is selected from the group consisting of an oxide of the reactive metal and a nitride of the reactive metal.

52. A diffusion barrier for a copper interconnect comprising a layer of titanium nitride covered by a layer of aluminum, wherein the grain boundaries of the titanium nitride layer are stuffed with aluminum oxide.

53. The diffusion barrier of Claim 52, wherein the layer of titanium nitride is deposited by atomic layer deposition (ALD).

54. The diffusion barrier of Claim 52, additionally comprising a second layer of titanium nitride between the aluminum layer and a copper filler.

55. A diffusion barrier for a copper interconnect comprising a layer of metal nitride covered by a layer of silicon, wherein the grain boundaries of the metal nitride layer are stuffed with silicon oxide.

56. The diffusion barrier of Claim 55, wherein the layer of metal nitride comprises titanium nitride.

57. The diffusion barrier of Claim 55, additionally comprising a second layer of metal nitride over the layer of silicon.

58. The diffusion barrier of Claim 57, wherein the second layer of metal nitride comprises titanium nitride.